

A REVIEW OF *CHITON CRISPUS*, REEVE, (ORDER POLYPLACOPHORA) AND ITS ALLIES, WITH PROPOSED RECOGNITION OF BLAINVILLE'S *CHITON LINEOLATUS*, AND DESCRIPTION OF THREE NEW SPECIES.

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PLATES XI. AND XII.

Whilst most Australian workers have been aware that under the name of *Ischnochiton crispus*, Reeve, several indetermined species have been bulked, no real attempt has been made to separate these forms and define their specific or sub-specific differences to assign their respective habitats. I did a good deal of preliminary work prior to July, 1919, and my thanks are due to Mr. W. L. May, who kindly examined a good deal of my material, and then expressed the opinion that there were four different species living together at Marino, in this State, and usually classed as one. My thanks are also due to Dr. W. G. Torr for material from St. Francis Island and Western Australia; to Mr. A. F. Bassett, Hull, for additional specimens from Port Jackson; and to Dr. John Shirley, for specimens from Caloundra.

The extreme variability in pattern and colouration and, to a lesser degree, in sculpture, of the group of shells we have hitherto designated as *Ischnochiton crispus*, Reeve, has made this one of the most tedious investigations I have attempted.

The use of a good binocular microscope was essential to the task, which has entailed the examination of some thousands of specimens from a great number of localities, extending from Caloundra, in Queensland, to Esperance, in Western Australia, and from many parts of Tasmania.

I propose to recognize *Chiton lineolatus* of Blainville in the large-scaled *Ischnochiton* of Tasmania, Victoria, and parts of South Australia, and to recognize *Ischnochiton crispus* of Reeve in the New South Wales shell, classing it as a sub-species of the former. Iredale and May's *Ischnochiton atkinsoni*, *sensu stricto*, is recognized as confined to Tasmanian waters, in both sculpture and colouration, showing very little variation. Then I define, as a sub-species of this latter, under the name of *lincolnensis*, Ashby, a form which is more variable and whose range extends from Victoria to Western Australia. A new species with minute scales is described under the name

of *Ischnochiton auratus*, Ashby, and another new species with erect scales under the name of *Ischnochiton properensis*, Ashby. A special paragraph is devoted to the juvenile forms of several species, as these differ so widely from the adults that they have continually been confused.

Ischnochiton lineolatus, Blainville (*Chiton lineolatus*, Blain., Dict. Sci. Nat., p. 541), non. *I. lineolatus*, Blain., of Ire. and May = *C. longicymba*, Blain., of Quoy and Gaimard = *I. haddonii*, of Pilsbry = *I. crispus*, Reeve, of Bednall = *I. crispus*, Reeve, of Torr.

Pilsbry (in Man. Con., vol. xv., p. 105) publishes a translation, and Ire. and May (Proc. Mal. Soc., vol. xii., pts. ii. and iii., p. 107) publish Blainville's original description. Ire. and May recognized *Ischnochiton contractus*, Reeve, of Pilsbry, as conspecific with Blainville's *Chiton lineolatus*; but Dupuis (Ex. Bull. Mus. Hist. Nat., 1918, No. 7) says, "Mr. Tom Iredale puts forward some ingenious hypotheses with regard to the synonymous rectification to be applied to several species, for example the *Chiton longicymba*, Blainville (I agree with him on this point), and the *Chiton lineolatus*, Blainville. Here the facts contradict his presumption. According to him the *C. lineolatus*, Blainville, must be the *Ischnochiton contractus* of Pilsbry, 1895, *et auct.* (non Reeve, 1847). Now the specimen of de Blainville, brought from King Island by Peron and Lesueur, is certainly not this species, but rather the *Chiton crispus*, Reeve, a species to which the description of de Blainville may otherwise be well applied. According to Iredale the typical *Chiton crispus* must be from New South Wales. It is certain that the *Ischnochiton contractus*, *auct.*, is not the *contractus*, Reeve, any more than it is the *lineolatus*, Blainville; the latter is the *Ischnochiton* of South Australia and Tasmania which has been regarded as *I. crispus*, Reeve, and which Iredale proposes as a distinct species under the name of *I. decoratus*, Sykes." M. Dupuis then names *I. lineolatus*, of Ire. and May, *Ischnochiton iredalei*, Dupuis, under which name it will now be known.

I am satisfied that the views expressed by M. Dupuis are sound. I therefore propose to recognize Blainville's *lineolatus* in the form common to Tasmania, Victoria, and South Australia, bearing large girdle scales, coarsely fluted (*auct. crispus*, Reeve).

The only alternative, as far as I can see, would be to recognize Ire. and May's *I. atkinsoni* as Blainville's species, but it is quite clear that his description could not apply to the Tasmanian form of that shell, and, further, the large-scaled form was very common at Penguin, in north-western Tasmania,

but I did not see a single specimen of *I. atkinsoni*, so, probably, it is a rare form in northern Tasmania. It is probable the same applies to King Island, which I have not visited.

Distribution.—I have pointed out in a previous paper that the shell under review occurs in the mouth of the Derwent, in Tasmania, but does not occur in the D'Entrecasteaux Channel. From the Derwent it extends round the eastern and northern coasts of that island; is common in Victoria, from Port Phillip, westward, reaching its western limit in Gulf St. Vincent, in South Australia. In Frederick Henry Bay and Port Arthur, in southern Tasmania, it appears to attain its highest development. I have specimens measuring 36×17 mm., and Mr. May has still larger ones, but the Victorian and South Australian open coast specimens are also often very fine; but in Gulf St. Vincent, although very common, it shows a distinct falling off in size, but maintaining the same characteristics as those from the localities previously named—of course the sculpture in these smaller specimens is proportionally less strong.

Ischnochiton crispus, Reeve (Con. Con., Reeve, pl. xix., fig. 120). The following is Reeve's description:—"The Crisped Chiton (Cuming Museum).—Shell elongately ovate, terminal valves, and lateral areas of the rest finely, decussately, crenulately crisped, central areas smooth, or under the lense very minutely reticulated; olive-green thickly painted with dots of a dark colour, ligament minutely, granulosely coriaceous, obscurely tessellated. Habitat, Australia. Note.—Allied to *C. longicymba*, but distinguished from that species by the minute decussated character of the sculpture of the lateral areas. May, 1847."

I propose to recognize in the New South Wales form Reeve's *Ischnochiton crispus*, which will be a sub-species of *Ischnochiton lineolatus*, Blainville. Reeve's figures are very good, and there can be no doubt as to the shell. It is similar in its remarkable range of marking and colouration to the southern form, and, if anything, in some specimens even more delicate in its colours. The sculpture is less coarse than is the normal character of that shell, Reeve's comment on the sculpture of the lateral areas being fairly appropriate, but the character of the scales on the girdle easily distinguishes it under a good binocular microscope, mag. 28 to 65 times; the flutes or ribs on the scales of the Sydney shell are narrower and the grooves correspondingly less deep, and although the scales are considerably larger than is the case with *I. atkinsoni*, Ire. and May, they are barely as large as those of *I. lineolatus*,

Blainville, in shells of a corresponding size. I have collected it at Bulli and Port Jackson, and have been furnished with additional material from that place by Mr. Hull, and from Caloundra, in Queensland, by Dr. John Shirley. The largest specimen I have in my collection measures 30×13 mm.

Ischnochiton atkinsoni, Ire. and May (Proc. Mal. Soc., pts. ii. and iii., Nov., 1916, p. 110). The size of the type is given as 8×4.5 mm., and senile shell as 13×7 mm., and the range given in their paper as northern Tasmania. Since then Mr. W. L. May has taken it in Little Norfolk Bay, southern Tasmania, and he and I took it in considerable numbers in the D'Entrecasteaux Channel. This extension of its range is somewhat interesting, especially the latter, as there *I. lineolatus*, Blainville, was entirely absent. The sculpture is most consistent, the coarse granules being always in evidence in the dorsal area as well as on other portions of the shell. While there is some divergence in colour from dark-brown through buff to dirty-white, this divergence is within very restricted limits.

Juvenile shells of this species are in the D'Entrecasteaux Channel living with large numbers of juvenile *Heterozona sub-viridis*, Ire. and May, described in the same paper. If anything, *I. atkinsoni* prefers deeper water. Except by means of a good lense it is difficult to separate juveniles of these two species, as the characteristic girdle scales of *sub-viridis* only put in an appearance at a later age, but the dorsal area, in the latter, is smooth.

ISCHNOCHITON ATKINSONI LINCOLNENSIS, n. sp.

Living with *I. lineolatus*, Blainville (*auct. I. crispus*), in Victoria at San Remo, and in South Australia at Encounter Bay, Cape Jervis, and Gulf St. Vincent, is a small-scaled *Ischnochiton* which was bulked with the large-scaled species, *I. lineolatus*, Blainville, until Ire. and May described from Tasmania *I. atkinsoni*. I have examined a very large series starting from Wilson Promontory, in Victoria, through the localities previously named; from Port Lincoln, where I collected a large series in January, 1917; from St. Francis Island, collected by Dr. Torr; from Venus Bay, collected by the writer, in February, 1910; and a few from Esperance Bay, in Western Australia, collected by Dr. Torr, which place seems the limit of its extension westward. From Port Lincoln, westward, *I. lineolatus*, Blainville, seems entirely absent, and its place is taken by the species now under review.

The following is a comparison with the Tasmanian shell:—The sculpture of *I. lincolnensis* in the pleural areas is similar

in character to *I. atkinsoni*, Ire. and May, but is decidedly less coarse, and the umbo has a larger smooth area; the lateral areas hardly show any of the radial sculpture of *atkinsoni*, being fairly constantly ornamented by much raised concentric ribs, or undulations, the ordinary granulose sculpture between the ribs. The "coarse nodulose radials" of *atkinsoni*, as described in the original description, are usually absent in this sub-species. Ire. and May mention that the radials are "dominated by the concentric growth-lines." Under a simple lens the rugged character of the sculpture of the Tasmanian shell is most consistent, whereas the mainland shell always seems to have a polished appearance, and the granulose sculpture is less in evidence.

The girdle scales are the same size as in *atkinsoni*, and the ribbing on the scales is a little more finely cut; most specimens of the latter show rougher and thicker scales, but this difference is not absolutely constant.

Ire. and May in the original description of *I. atkinsoni* (Proc. Mal. Soc., vol. xii., pts. ii. and iii., 1916) state that the colour is "uniform buff," whereas Mr. May and I have collected it in southern Tasmania more often of a dingy grey, or greyish-white, with a buffish dorsal streak; others, again, are distinctly rufous.

The sub-species now under consideration shows a much greater range of variation. At San Remo, in Victoria, from which place I have a long series, a very wide range of variation exists. I quote from Ridgway's Colour Standards. Many are drab (pl. xlv.), similar to the southern Tasmanian shells; others, again, are tawny-olive to verona-brown (pl. xxix.). Two specimens are prussian-green (pl. xix.), with a white dorsal band; another is dark grey with a white dorsal band. From Cape Jervis, in South Australia, are specimens varying from cream through pale-greenish shades to almost black with cream girdle. Then at Marino the prussian-green and a still more blue form occurs, also specimens ivory-white to buff. Then at Port Lincoln they vary from pale greenish, through grey shades and cream, orange-cinnamon (pl. xxix.), to chestnut.

In nearly all there is a characteristic pattern which may be described as a broad, central, lightish band with a crenulate darker band on each side; in a few cases this pattern is reversed, the central band being dark and the edging light. The girdle mostly shows banding.

Hab.—I am indebted to Mr. James Kershaw for specimens collected by himself at Wilson Promontory, Victoria, which place probably forms the eastern extension of its range,

and to Dr. Torr for the examination of two small specimens from Esperance Bay, in Western Australia, which place is probably about the limit of its extension westward. It is rather a curious fact that all the specimens from these two widely-separated localities are creamy-white and show none of the variations so common in the intermediate localities.

Juvenile Forms.—For a long time both Mr. May and I have been under the impression that a number of small, broad, flattish shells of 6 mm. and under in length, with a uniform, shallow, granulose sculpture and smooth dorsal areas, were a distinct species; but on the examination of a very long series, I have come to the conclusion that they are the juvenile form of *I. lincolnensis*, Ashby. The smooth dorsal area in this juvenile form separating it easily from the juveniles of the dominant species from Tasmania.

Ever since February, 1910, when I collected a nice series of this shell at Venus Bay, South Australia, I have considered it a distinct species, but was unable with imperfect instruments to define its distinguishing characteristics. Practically none of the characteristic variations of colour pattern common to *I. lineolatus*, Blainville, and *I. crispus*, Reeve, are met with in this species.

ISCHNOCHITON AURATUS, n. sp.

General Appearance.—Shell glossy, elliptical, sub-carinated, arched, side slope rounded, half as wide as long, finely decussated.

Colour.—Type xanthine-orange, para-type orange-buff, Ridgway's Colour Standards (pl. iii.).

Anterior Valve.—Slope rather steep, slightly convex, evenly decussated, under $\times 28$, with small, flat, polished pustules; in the outer half of valve these pustules run together, in places, giving an ill-defined appearance suggestive of concentric arrangement or growth-lines.

Posterior Valve.—Mucro well defined, central, the anterior portion of valve and the part immediately behind the mucro minutely decussated and polished, but the mucro itself and surrounding portions almost smooth and very highly polished. The outer half of valve decorated with three concentric, more or less broken, coarsely pustulose ribs.

Median Valves.—Dorsal area not beaked, posterior part smooth and highly polished, this feature extending into the adjoining portions of pleural and lateral areas. Pleural area evenly and finely decussated, highly polished, the outer portion decorated with three concentric ribs of same character as posterior valve.

Girdle.—Clothed with minute, imbricating, flat, highly-polished scales, apparently smooth, but under 65 mag. there is a suggestion of fine scratching. The scales are mostly the same orange colour as the rest of the shell, but a few are buff-orange. The scales remind one of minute, thin, rounded-edged biscuits with the sides uppermost. I can see no girdle fringe on the type, but there is one present in the juvenile specimen collected at Venus Bay.

Measurements.—Type a little more than 8×4 mm., the para-type $9 \times 4\frac{1}{2}$ mm., girdle rather incurved.

Hab.—Two specimens collected by myself at Marino, South Australia, and one only, $4\frac{1}{2}$ mm. in length, I collected at Venus Bay in February, 1910.

In Conclusion.—This is evidently a rare species; the only striking general characteristic is its rich orange colour and highly-polished surface. It is easily confused with juvenile *Heterozona cariosus*, Pilsbry, but the scales in that species are larger and definitely ribbed. The smallness of the scales, as well as their being unribbed, will separate it from juveniles of *lineolatus*, Blainville, and *lincolnensis*, Ashby, and whereas *I. torri*, Ire. and May, has scales about as small they are always striated, and the shell of this latter is rounded, not sub-carinated.

ISCHNOCHITON (HETEROZONA) PROPERENSIS, n. sp.

General Appearance.—Dingy brown, about twice as long as broad, sub-carinated, flat, side slope slightly rounded, coarsely decussated, and lateral areas concentrically ribbed.

Colour.—More or less Saccardo's umber all over (Ridgway's Colour Standards, pl. xxix.).

Anterior Valve.—Upper fourth, finely decussated, radially ribbed with about forty closely-packed, broken ribs, several clearly-marked growth-lines in evidence, becoming more raised towards the outer margin.

Posterior Valve.—The anterior portion definitely separated from the rest by diagonal lines; this portion, as well as that immediately below the mucro, strongly decussated or granulose, the posterior portion concentrically ribbed with four rows of coarse pustules, remarkably regular, and looking like a string of beads.

Median Valves.—Lateral areas raised, concentrically ribbed with about 10 strongly-raised ribs which are broken by about 8, fairly deep, equidistant, radial grooves, with the result that the concentric ribs are broken into coarse, squarish pustules. Pleural and dorsal areas are coarsely decussated with a system of closely-packed flatish pustules.

Girdle.—Is broad, covered with rather large, finely-striated scales, placed at a more or less erect angle and barely imbricating; they are not pointed as in *cariosus*, Pilsbry; the striae are not carried to the apex—this latter is smooth. As compared with *I. lincolnsensis*, Ashby, they are much larger and more clumsy. The semi-erect character of the scales gives them a chaffy appearance, and distinguishes this *Ischnochiton* from any of our other true *Ischnochitons*.

Hab.—I collected the type and one or two other specimens near Port Lincoln, in South Australia, in January, 1917, near the head of an almost land-locked bay, called Proper Bay. I did not meet with it elsewhere.

In Conclusion.—I submitted the type and foregoing description to my friend, W. L. May, for his comments, and select from the latter the following:—"I think your shell is a new species of *Heterozona*, as represented by *sub-viridis*, Ire. and May, with a typical *sub-viridis* girdle but the sculpture of *I. atkinsoni*, Ire. and May." Thinking that this comment will be helpful I have quoted it, and also adopt his suggestion to include the species under the sub-genus *Heterozona*, for the erect character of the scales certainly suggests affinity therewith, also the outer scales are small, increasing to large scales near the shell; but in the species under review, although somewhat irregular, the large scales do not appear in the midst of the smaller ones, nor are they as pointed or prominent as in typical members of this sub-genus, but are similarly finely striated. I conclude, therefore, that it is a slightly modified form of *Heterozona*.

Note.—Just as I was leaving for America, in May, 1918, I had hurriedly to close up the papers I was then writing on Polyplacophora, and wishing at the time to recognize the work done by Mr. F. L. Saunders by naming a species after him, I selected a striking specimen from my collection, giving a brief description only, under the generic name of *Anisoradsia*. I had at that time no opportunity of making a careful examination with a good instrument. On returning from America I felt dissatisfied with the generic identification and sent the type to Mr. Tom Iredale for comparison with a similar specimen I had sent him in 1917, and asking for his opinion.

In the investigation of material for purposes of this paper I have found features connected with *Heterozona cariosus*, C. and P., which lead me to conclude that the shell I named *Anisoradsia mawlei saundersi*, Ashby, was a divergent form of that shell. Until the type is returned to me this must remain an open question.

I have now received a reply from Mr. Tom Iredale, dated July 7 last, in which he says, "The form *saundersi* appears to belong to *cariosus*, but I have not definitely settled it." This rather confirms my surmise. (See note Trans. Roy. Soc. S. Austr., vol. xliii., 1919, p. 73.)

JUVENILE FORMS.

It appears that very little has been done in the identification of the juvenile forms of the various species of Australian chitons. In the course of my investigations I have found that it is no unusual thing for the chiton in its juvenile stage to differ so widely from the adult that it has been classed as a different species. Thus the distinguishing features of the adult are often entirely absent in the young, and the juveniles of widely-separated forms have been confused together.

I now add some notes on this subject, my conclusions being founded on the examination of a very long series and from a large number of different localities:—

I. atkinsoni, Ire. and May, and *H. sub-viridis*, Ire. and May.—Juveniles of these two rather widely-separated forms are found living together in southern Tasmania, and are difficult to separate. The smooth dorsal area of the latter separates it from *atkinsoni*, and the scales of *atkinsoni* are larger and more strongly striated.

I. atkinsoni lincolnensis, Ashby.—The juvenile form has the whole of the dorsal area smooth; all other areas are finely decussate, and the shell, proportionately broader than the adult form, is often rich buff, sometimes pure white. This was the shell that was wrongly identified as *I. pura*, Sykes, in my 1918 Distribution List. This species always has striated scales, whereas in *I. pura* they are smooth.

Heterozona cariosus, Pilsbry.—Juveniles of this species up to a very considerable size—anyhow up to 12 mm. in length—show none of the large pointed scales which are the distinguishing character of the genus.

These juvenile shells have been classed as "red or orange," *I. crispus*, Reeve, by most collectors, and, latterly, as *I. atkinsoni*, Ire. and May, they having in common with that species small, finely-striated scales. They can be separated from *I. lincolnensis*, Ashby, by their lack of carination, the shell being evenly arched, and also by the scales not being bent over. In size and shape the scales are very similar.

Some six months ago I examined the shell that is recorded by Dr. Torr (Trans. Roy. Soc. S. Austr., vol. xxxvi.,

1912) as *Ischnochiton greyi*, Filhol, and which had been sent to Mr. Suter and identified by him as his New Zealand shell, *I. fulvus*, both the foregoing names being synonyms for *campbelli*, Filhol. I compared it with this species, with which it certainly does not agree, and my note goes on to say, "This is really Ire. and May's *I. atkinsoni*, as the scales correspond with that species." It is just possible that it may be one of these larger juveniles of *H. cariosus*, Pilsbry. It is certainly referable to one or the other of these two species.

SUMMARY.

Name.	Habitat.	Distinguishing Characters.
<i>Ischnochiton lineolatus</i> , Blainville	Gulf St. Vincent. S. Austr., to San Remo, Vict.; north, east, and south coast Tasmania to River Derwent	Large scales on girdle with broad, much-raised fluting
<i>I. lineolatus crispus</i> , Reeve	Bulli, N.S. Wales, to Caloundra, Q'land	Rather smaller scales, fluting narrower and less raised
<i>I. atkinsoni</i> , Ire. and May	North, east, and south Tasmania	Small, finely-striated scales, decussate sculpture very strong
<i>Heterozona sub-viridis</i> , Ire. and May	Tasmania and Vict.	Juvenile shell arched, dorsal area smoother, scales small, finely striate
<i>Ischnochiton atkinsoni lincolnensis</i> , Ashby	From Wilson Promontory, Vict., to Esperance Bay, W. Austr. Takes the place entirely of <i>lineolatus</i> westward of Port Lincoln	Scales similar to foregoing, dorsal area smoother, decussate sculpture generally less strong
<i>I. auratus</i> , Ashby	Gulf St. Vincent and Venus Bay, S. Austr.	Scales minute, practically smooth, orange, highly polished
<i>Heterozona cariosus</i> , Pilsbry	Tasmania, Victoria, S. Austr., and W. Austr.	Juvenile shell arched, not carinated
<i>Ischnochiton (Heterozona) properensis</i> , Ashby	Pt. Lincoln, S. Austr.	Scales medium size, finely striated, erect, decussate sculpture rather coarser than <i>lincolnensis</i>

DESCRIPTION OF PLATES.

PLATE XI.

- Fig. 1a. *Kopionella tasmanica*, Ashby, anterior valve, $\times 5$.
 „ 1b. „ „ „ median valve, $\times 5$.
 „ 1c. „ „ „ posterior valve, $\times 5$.
 „ 1d. „ „ „ showing 3 classes of girdle
 spicules.
 „ 2. *Haploplax mayi*, var. *viridis*, Ashby, shell, $\times 10\frac{1}{2}$.
 „ 3. *Ischnochiton lineolatus*, Blainville, showing girdle scales,
 $\times 28$.
 „ 4. „ „ *crispus*, Reeve, showing girdle scales, $\times 17$.

PLATE XII.

- Fig. 5a. *Ischnochiton atkinsoni lincolnensis*, Ashby, shell, $\times 6$.
 " 5b. " " " " " showing girdle scales, $\times 28$.
 " 6a. " *auratus*, Ashby, shell, $\times 8$.
 " 6b. " " " " " showing girdle scales and anterior valve, $\times 28$.
 " 7a. " *properensis*, Ashby, shell, $\times 4\frac{1}{2}$.
 " 7b. " " " " " showing girdle scales, $\times 28$.

NOTE.—The girdle scales with one exception are the same magnification, thus showing the relative sizes of the scales.